

## CLAIMS

1. An operating apparatus comprising:
  - a driven element;
  - a frame which rotatably supports the driven element;
  - a contacted element which is stationary with respect to the driven element; and
  - a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the contact portion of the vibrating element abutting on the contacted element;

wherein the vibrating element transmits power to the driven element via the contacted element to rotate the driven element.
2. The operating apparatus as claimed in claim 1, wherein the contacted element is fixedly provided on the driven element.
3. The operating apparatus as claimed in claim 1, wherein the vibrating element is fixedly provided on the frame.

4. The operating apparatus as claimed in claim 1, wherein the vibrating element has a thin plate-shaped structure, and the contacted element and the vibrating element are provided in a substantially same plane.

5. The operating apparatus as claimed in claim 1, wherein the driven element has a side surface and the frame has an inner wall surface which is opposite to the side surface of the driven element through a gap therebetween, and the contacted element and the vibrating element are arranged within the gap.

6. The operating apparatus as claimed in claim 1, wherein the vibrating element is arranged so that a longitudinal direction thereof is parallel to a width direction of the frame, and the contacted element is arranged on a line extended to the longitudinal direction of the vibrating element.

7. The operating apparatus as claimed in claim 1, wherein the contacted element and the vibrating element are arranged so as to overlap each other when viewed from a top of the operating apparatus.

8. The operating apparatus as claimed in claim 1, further comprising a decelerating mechanism between the contacted element and the driven element.

9. The operating apparatus as claimed in claim 1, further comprising means for pushing one of the contacted element and the vibrating element toward the other.

10. An operating apparatus comprising:

a driven element;

a first frame which receives the driven element;

a second frame which rotatably supports the first frame;

a contacted element which is stationary with respect to the first frame;

and

a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the contact portion of the vibrating element abutting on the contacted element;

wherein the vibrating element transmits power to the first frame via the contacted element to rotate the first frame.

11. The operating apparatus as claimed in claim 10, wherein the driven element is rotatably supported in the first frame, and the driven element and the first frame respectively have rotational axes in which an axial direction of the

rotational axis of the driven element with respect to the first frame is different from that of the first frame with respect to the second frame.

12. The operating apparatus as claimed in claim 11, wherein the rotational axis of the driven element with respect to the first frame is substantially orthogonal to that of the first frame with respect to the second frame.

13. The operating apparatus as claimed in claim 10, wherein the vibrating element has a thin plate-shaped structure, and the contacted element and the vibrating element are provided in a substantially same plane.

14. The operating apparatus as claimed in claim 10, wherein the first frame has a side surface and the second frame has an inner wall surface which is opposite to the side surface of the first frame through a gap therebetween, and the contacted element and the vibrating element are arranged within the gap.

15. The operating apparatus as claimed in claim 10, wherein the first frame has a bottom portion and the second frame has an inner wall surface and an inner bottom surface, the contacted element and the vibrating element are arranged within a space defined by the bottom portion of the first frame and the inner wall surface and the inner bottom surface of the second frame, and the vibrating element and the contacted element transmit power to the first frame through the bottom portion of the first frame.

16. The operating apparatus as claimed in claim 10, further comprising a decelerating mechanism between the contacted element and the first frame.

17. The operating apparatus as claimed in claim 10, wherein the contacted element has a gear and the first frame has tooth grooves so that the tooth grooves which are in engagement with the gear so that the contacted element transmits the power of the vibrating element to the first frame via the gear and the tooth grooves.

18. The operating apparatus as claimed in claim 10, wherein the contacted element is fixedly provided on the first frame.

19. The operating apparatus as claimed in claim 10, wherein the contacted element is fixedly provided on the second frame.

20. The operating apparatus as claimed in claim 19, wherein the vibrating element is fixedly provided on the first frame so as to rotate together with the first frame.

21. The operating apparatus as claimed in claim 20, wherein the inner wall surface of the second frame constitutes the contacted element, and the vibrating element abuts on the inner wall surface of the second frame to transmit its vibration to the inner wall surface and to receive reaction force from the inner

wall surface so that the first frame is rotated together with the vibrating element by means of the reaction force.

22. An operating apparatus comprising:

- a driven element;

- a first frame which rotatably supports the driven element;

- a first contacted element which is stationary with respect to the driven element;

- a first vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element of the first vibrating element being laminated in this order, and the contact portion of the first vibrating element abutting on the first contacted element;

- a second frame which rotatably supports the first frame;

- a second contacted element which is stationary with respect to the first frame; and

- a second vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the

second piezoelectric element of the second vibrating element being laminated in this order, and the contact portion of the second vibrating element abutting on the second contacted element;

wherein the first vibrating element transmits power to the driven element via the first contacted element to rotate the driven element with respect to the first frame, and the second vibrating element transmits power to the first frame via the second contacted element to rotate the first frame with respect to the second frame.

23. An electric instrument provided with an operating apparatus, the operating apparatus comprising:

a driven element;

a frame which rotatably supports the driven element;

a contacted element which is stationary with respect to the driven element; and

a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the contact portion of the vibrating element abutting on the contacted element;

wherein the vibrating element transmits power to the driven element via the contacted element to rotate the driven element.

24. An electric instrument provided with an operating apparatus, the operating apparatus comprising:

- a driven element;

- a first frame which receives the driven element;

- a second frame which rotatably supports the first frame;

- a contacted element which is stationary with respect to the first frame;

and

- a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the contact portion of the vibrating element abutting on the contacted element;

- wherein the vibrating element transmits power to the first frame via the contacted element to rotate the first frame.

25. An electric instrument provided with an operating apparatus, the operating apparatus comprising:

- a driven element;

- a first frame which rotatably supports the driven element;

- a first contacted element which is stationary with respect to the driven element;



a first vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element of the first vibrating element being laminated in this order, and the contact portion of the first vibrating element abutting on the first contacted element;

a second frame which rotatably supports the first frame;

a second contacted element which is stationary with respect to the first frame; and

a second vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element of the second vibrating element being laminated in this order, and the contact portion of the second vibrating element abutting on the second contacted element;

wherein the first vibrating element transmits power to the driven element via the first contacted element to rotate the driven element with respect to the first frame, and the second vibrating element transmits power to the first frame via the second contacted element to rotate the first frame with respect to the second frame.